

THE CENTRAL BANK OF THE REPUBLIC OF TURKEY

THE TERM STRUCTURE OF INTEREST RATES: DOES IT TELL ABOUT FUTURE INFLATION?

**Gülbin ŞAHİNBEYOĞLU
Cihan YALÇIN**

**RESEARCH DEPARTMENT
Discussion Paper No: 2000/2**

**ANKARA
March, 2000**

All the views expressed in this paper belong to the authors and do not represent the views of the Central Bank of the Republic of Turkey.

Prepared by:
The Central Bank of the Republic of Turkey
Head Office
Research Department
İstiklal Cad. 10
06100 Ulus, ANKARA
TURKEY

For additional copies please address to:
The Central Bank of the Republic of Turkey
Head Office
General Secretariat
(Library and Documentation Division)
İstiklal Cad. 10
06100 Ulus, ANKARA
TURKEY

The Term Structure of Interest Rates: Does it Tell About Future Inflation?

Gülbin ŞAHİNBEYOĞLU*
Cihan YALÇIN*

Affiliation and Correspondance:

Research Department
The Central Bank of the Republic of Turkey
06100 Ulus Ankara TURKEY

E-mail: gulbin.sahinbeyoglu@tcmb.gov.tr

ABSTRACT

Central banks of many countries have increasingly focused on the goal of price stability. In pursuing of this goal, central banks need information on the degree of inflationary pressures in the economy as well as the nature of monetary transmission mechanism. In addition to information in the monetary aggregates, the information endorsed in the financial markets has become important in understanding of monetary transmission mechanism. One of the financial indicators that can be used as a guide for monetary policy is the term structure of interest rates in bonds and bills market. In this framework, this study examines empirically what the term structure of interest rates tells us about future path of inflation in Turkey. Contrary to the expectations and previous studies carried out for OECD countries, the estimation results of this study suggest that the term structure of nominal interest rates have a significant but negative impact on the future path of inflation. This impact is weak at the very short end of data that is 3-month maturity. Highly volatile pattern of real interest rates due to imperfections in relatively undeveloped financial market and uncertainties in macroeconomic environment are the main reasons of this result. Furthermore, the fluctuations in the slope of the term structure mostly reflect the changes in the term structure of real interest rates on a one-for-one basis, in other words, the slope of the term structure of real interest rates is not constant over time.

* This paper was presented at international conference on "Banking, Financial Markets and the Economies of the Middle East and North Africa", Lebanon, May 23-25, 2000, and ERC-METU Conference in Economics, Ankara, September 13-16, 2000. The authors thank to Ali Çufadar for supplying them with data. They also thank to C. Emre Alper for his helpful comments.

I. INTRODUCTION

Central banks of many countries have increasingly focused on the goal of price stability. In pursuing of this goal, central banks need information on the degree of inflationary pressures in the economy as well as the nature of monetary transmission mechanism. The instability of money demand in mid-1980s reduced the reliability of money-based intermediate target rules in most countries.¹ In addition to the information in the monetary aggregates, the information endorsed in the financial markets has become important in understanding of monetary transmission mechanism that is also becoming a more complicated process. One of the financial indicators that can be used as a guide for monetary policy is the term structure of interest rates in bonds and bills market or the yield curve.

Financial instability caused by less developed financial markets induce uncertainty in investment decisions of the economic agents as in the case of Turkey. The information in the financial indicators that can be used by the policy makers as a complement to the information in monetary aggregates may be useful for the conduct of monetary policy especially in developed financial markets. Even in less developed financial markets, a detailed and a careful analysis of the financial indicators can be a useful guide for conducting monetary policy.

It is generally accepted that the information contained in the term structure of interest rates may be a useful guide for understanding of the monetary policy stance, whether it is tight or loose. This is also an important topic for researchers in providing information about future path of inflation and economic activity. In

¹ Mylonas and Schich (1999).

general, a positively sloped and relatively steeper yield curve implies that monetary policy is loose and thus inflation rate will increase in the future, while it is expected that monetary policy is tight where the yield curve is relatively flatter or negatively sloped. A tight monetary policy entails an increase in the short-term nominal interest rate relative to long-term interest rates, and thus lower inflation rate is expected in the future.

The term structure of interest rates might contain information about the future path of inflation. This theory has been studied, debated and tested by a very large number of researchers. There are two broad lines of research. Research beginning with Fama (1975) finds that the level of interest rates helps forecast future path of inflation, while recent research has focused on the information in the term structure about future interest rate movements.

In this framework, this study examines empirically what the term structure of interest rates tells us about future path of inflation in Turkey. Thus learning about the ability of the term structure to forecast the future path of inflation is an important knowledge for the Central Bank of Turkey to have, because it will help policymakers to decide whether using the term structure as a guide for monetary policy is a sensible strategy. However, the financial markets in Turkey are not deep and broad enough to extract appropriate information. Therefore, one should evaluate this information with caution.

The remainder of this paper is organised as follows: In section II, previous empirical work on the term structure of interest rates is summarised. In the following section, section III, the developments in the primary and secondary bonds and bills markets in Turkey are summarised, and a descriptive analysis of the term structure of interest rates is provided. Section IV is devoted to the methodology

that is used in the study and the hypothesis whether the interest rate spread explains the future path of inflation is tested. The empirical results are reported and discussed in this section. Last section provides concluding remarks and policy suggestions.

II. PREVIOUS EMPIRICAL WORK

An understanding of the relationship between short and long-term interest rates is of fundamental importance for a number of questions in monetary and financial economics. One possible reason is the information in the term structure about future path of inflation and requires careful study as it bears directly on whether central banks should use the term structure as a guide for monetary policy. There is a substantial amount of empirical evidence on the term structure of interest rates and this section summarises certain lines of research on the term structure of interest rates.

The nominal interest rates are generally decomposed into two parts, namely real interest rate and expected inflation. Fisher (1930) claims that inflation has no impact on real interest rate and there is only a correlation between nominal interest rate and inflation. The direction of the causality between nominal interest rate and inflation has been debated by many studies in this literature. Sargent (1973) shows statistically that inflation and nominal interest rate cause each other simultaneously. Research beginning with Fama (1975) often finds that the level of interest rates helps forecast future inflation, while other research focused on the information in the term structure about future interest rate movements. Fama (1975) studies on interest rates as predictors of inflation and suggests that movements in nominal interest rates primarily reflect fluctuations in expected inflation rather than changes in real interest rates. Subsequent works as Nelson and Schwert (1977), Mishkin (1981) and Fama and

Gibbons (1982) support this conclusion for the postwar period in United States with an exception of 1979-1982 where the Federal Reserve operating procedures changed.

Mishkin (1990a, 1990b, and 1991), in particular, have written on this subject. Mishkin (1990a) examined the term structure for US Treasury bills and found that for maturities of six months or less, the term structure of nominal interest rates provided almost no information about the future path of inflation. On the other hand, at this shorter end of the term structure of nominal interest rates does contain a great deal of information about the term structure of real interest rates. However, for longer maturities of nine and twelve months, the term structure of nominal interest rates provides information about the future path of inflation, although it contains little information about the term structure of real interest rates.

In a further study, Mishkin (1990b) conducts a different approach and looks at the information in the longer maturity term structure by examining data from US Treasury bonds with maturities of one to five years. The evidence in the study indicates that at longer maturities, the term structure of interest rates can be used to help assess future inflationary pressures. In other words, when the slope of the term structure steepens, it is an indication that the inflation rate will rise in the future and when the slope falls, it is an indication that the inflation rate will fall. These results are consistent with those of Fama (1990) that also finds that at longer maturities the term structure explain future inflation better. Additionally, Mishkin (1991) expands the analysis and examines data from ten OECD countries. This study suggests that the shorter maturity term does not contain a great deal of information about the future path of inflation.

Estrella and Mishkin (1997) examines the relationship of the term structure of interest rates to monetary policy instruments and to subsequent economic activities and inflation rate both in Europe and in US. It concludes that the term structure of interest rate can be used for predicting of economic activity and inflation. Therefore, term structure of interest rates is advised to be a comprehensive source of information for future inflation, but not an instrument for European monetary policy. Similarly, Davis and Fagan (1997) uses the data of European Union countries and shows that financial spread variables do contain information about future inflation and output. However, the estimated parameters are not completely stable, thus they are not suggested to be used as appropriate indicators for future inflation.

In a different approach, Frankel and Lown (1994) applied the existing framework which let the real interest rate vary in the short run but converge to a constant in the long run. The appropriate indicator of expected inflation was based on the estimation of the steepness of a specific non-linear transformation rather than a restriction to a spread between two points. The resulting indicator performed better in predicting inflation over period of 1960-1991 for US data.

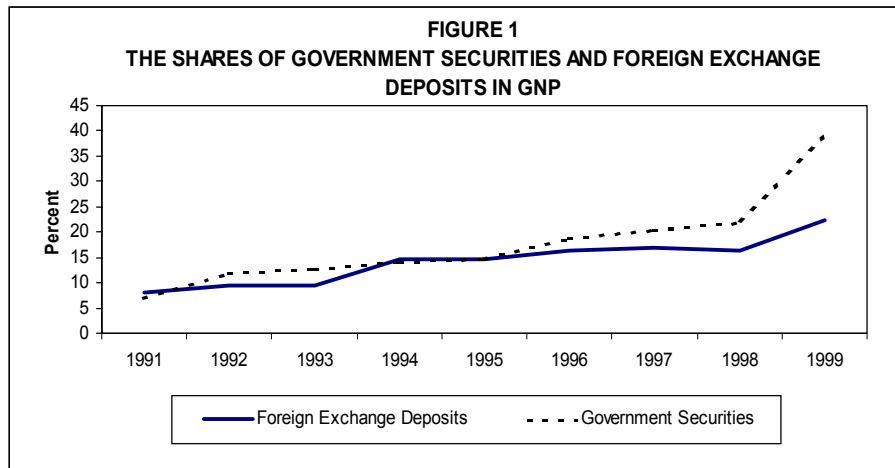
On the other hand, in relating two interest of different terms, the Expectations Theory of the term structure of interest rates combined with the assumption of rational expectations states that the interest rate of the longer maturity asset can be expressed as a weighted average of the present and expected future interest rates of the shorter maturity asset. This theory has been studied, debated and tested by a very large number of researchers. Since the mid 1980's, a considerable amount of empirical evidence has been suggested that the explanatory power of the expectations hypothesis may be greater

than previously thought². Fama (1984) studied the behaviour of interest rates in the US with maturities 1-6 months and showed that forward interest rates do contain information about future 1-month rates. Similar study by Mankiw and Miron (1986) analysed the behaviour of 1- and 6- month interest rates in the US over the period 1890-1979 and showed that the expectations hypothesis received considerable support in data till the foundation of Federal Reserve System in 1913.

III. BONDS AND BILLS MARKETS: TURKISH EXPERIENCE

The Turkish economy has experienced a widespread financial liberalization over the past ten years. Financial markets relatively deepened while the government securities market expanded considerably. New financial instruments, such as treasury bills, repos, equities appeared as alternative instruments to bank deposits. During 1987-99 period, the growing public sector deficits have been financed heavily through the auction market by issuing government bonds and Treasury bills. The ratio of government securities to the GNP increased sharply from 5.8 percent in 1987 to 21.9 percent in 1998 and the increase in the volume of government securities has accelerated especially after 1990. It can be claimed that the liberalization of capital accounts enhanced short-term capital inflows, which were converted to Turkish lira by the banks in order to purchase government securities with higher rate of returns. The increasing trend of the ratio of foreign exchange deposits and government securities to GNP exhibited a parallel path after 1991 (Figure 1).

² Gerlach and Smets (1997).



The understanding of the structures as well as the functioning of these rapidly growing markets has crucial importance in extracting "appropriate" information. In this context, this section aims to give a brief historical background in the establishment of the Istanbul Stock Exchange as well as to summarise the fundamentals of the primary and secondary markets of bonds and bills in Turkey.

III.A. Istanbul Stock Exchange

The early phase of 1980s had witnessed a marked improvement in the legislative framework of the capital market and the Stock Exchange. In 1981, the "Capital Market Law" was enacted. The regulations concerning operational procedures were approved in the subsequent extraordinary meetings of the General Assembly and the Istanbul Stock Exchange (ISE) was formally inaugurated at the end of 1985.

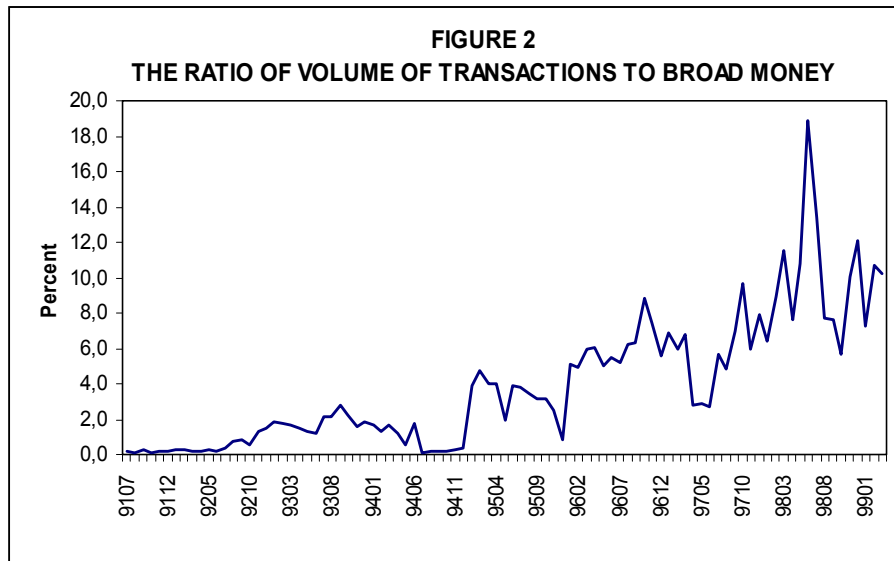
The ISE incorporated three markets: the Stock Market, the Bonds and Bills Market and the Repo/Reverse Repo Market. Bonds and Bills Market was initiated on June 1991. The aim was to increase the liquidity in fixed income securities by creating a centralised market

on which trading could take place in transparent and competitive conditions.

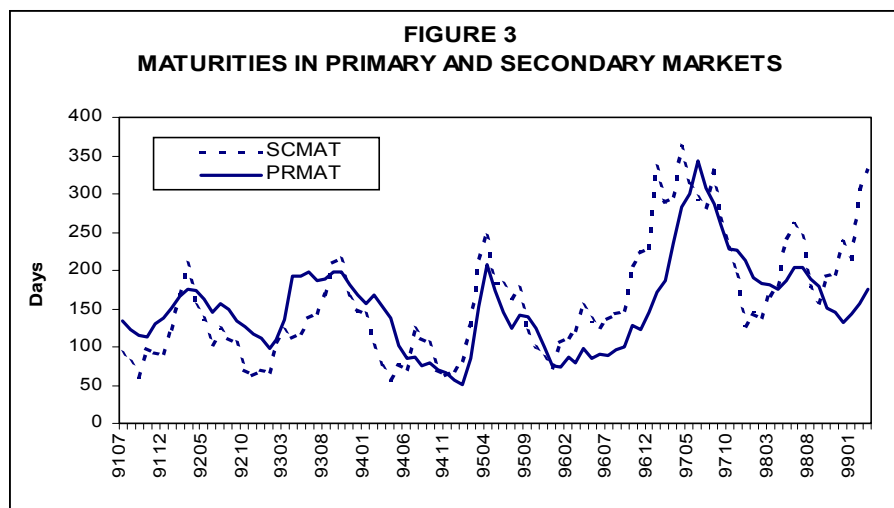
Central Bank of Turkey as well as ISE member banks and brokerage firms are permitted to trade on the Bonds and Bills Market. Bonds and Bills Market is the only organised, semi-automated market for both outright purchases and sales and repo/reverse repo transactions. The purpose of the market is to provide a transparent, liquid, competitive and efficient environment for secondary market trading of fixed-income securities comprising Government bonds, Treasury bills, revenue-sharing certificates, bonds issued by the Privatization Administration and corporate bonds listed on the ISE. Although there is a market for the securities stated above, most of the transactions are conducted on Treasury bills and Government bonds. The Bonds and Bills Market was established on June 17, 1991 while repo/reverse repo transactions began on February 17, 1993. In a recent development, the Real Estate Certificates Market was launched on June 3, 1996 within the ISE Bonds and Bills Market.

III.B. Primary and Secondary Markets: Bonds and Bills

As mentioned previously, ISE Bonds and Bills Market was initiated on June 1991 with the aim of increasing the liquidity in fixed income securities by creating a centralised market on which trading could take place in transparent and competitive conditions. The volume of transactions of ISE Bonds and Bills Market has increased substantially since the establishment of the market. The ratio of the volume of transactions to broad money, M2X, increased from 0.2 percent in July 1991 to 10.3 percent in March 1999 (Figure 2).



The average maturity of the transactions in the Bonds and Bills Market is considerably short. This structure mainly stems from the macroeconomic instabilities as well as the public borrowing policy of the Turkish Government. Government finances budget deficits mainly through issuing Treasury bonds and bills. Uncertainty in macroeconomic environment is the other main reason of the shorter maturity of transactions in both primary and secondary markets. On



the other hand, the maturity structures of primary and secondary markets of government bonds and bills have similar trends, even though the secondary market is more volatile. The maturities in both markets are concentrated around 5 months. The short maturity in the secondary market can be considered as a bottleneck for extracting appropriate information in the conduct of monetary policy (Figure 3).

Similar to the maturity structures of the markets, sale-weighted average interest rates in primary market and transaction volume-weighted interest rates in secondary markets have parallel patterns. After the financial crisis in 1994, the interest rates have become more volatile. The interest rates with average of 3-month and 6-month maturities in the secondary market remained generally below the weighted average of interest rates in primary market during the analysed period of 1991-1999.

The interest rate spread or the slope of the term structure of interest rates defined as the differential between long-term and short-term interest rates exhibits a volatile pattern during the analysed period. The average maturity in this market has become extremely short in the whole period where the long-term was considered as nine-month or one-year maturity with a substantial missing data. Therefore, a yield of six-month maturity is evaluated as a relatively longer term for Turkish case. Before the financial crisis of 1994, the interest spreads in the secondary market fluctuated around zero and have smooth patterns. After the crisis, the pattern in interest rate spreads had changed to a large extent. In other words, the fluctuations had become more frequent with widening ranges and the yield spreads had become generally positive (Table 1, Figure 4).

TABLE 1
TRANSACTION VOLUME-WEIGHTED INTEREST
RATES IN SECONDARY MARKET

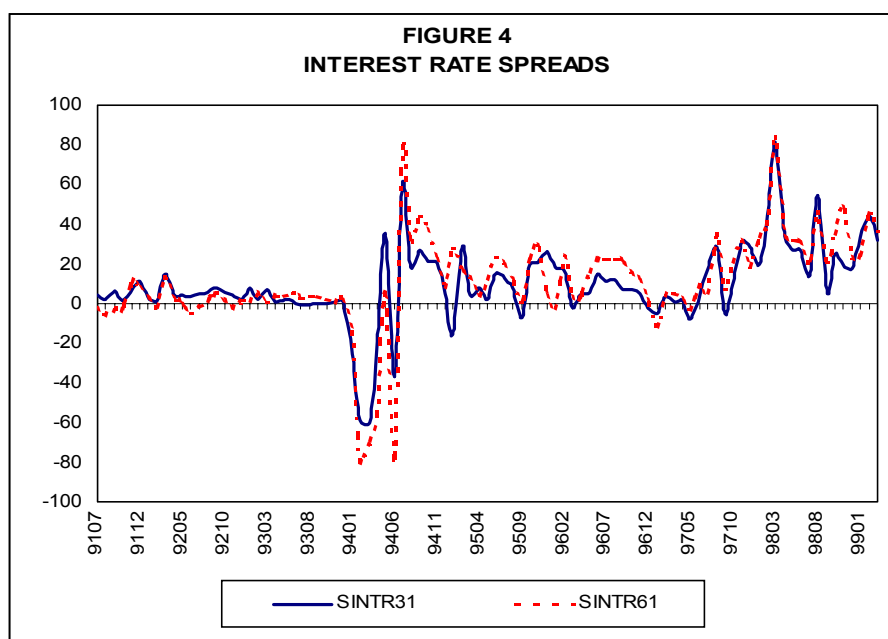
	1-Month	3-Month	6-Month	9-Month	12-Month
1991(*)	80.5	86.0	81.2	77.5	75.7
1992	87.2	92.5	88.6	80.5	75.5
1993	83.7	85.5	86.6	87.6	85.8
1994	176.8	175.8	171.2	123.8	123.6
1995	107.1	117.3	122.8	114.7	107.4
1996	118.3	126.5	131.5	120.7	113.4
1997	92.2	101.2	102.5	101.4	100.2
1998	73.1	104.0	110.5	107.7	101.4
1999(**)	84.2	120.7	119.6	121.6	119.8

Source: Daily basis transactions from ISE.

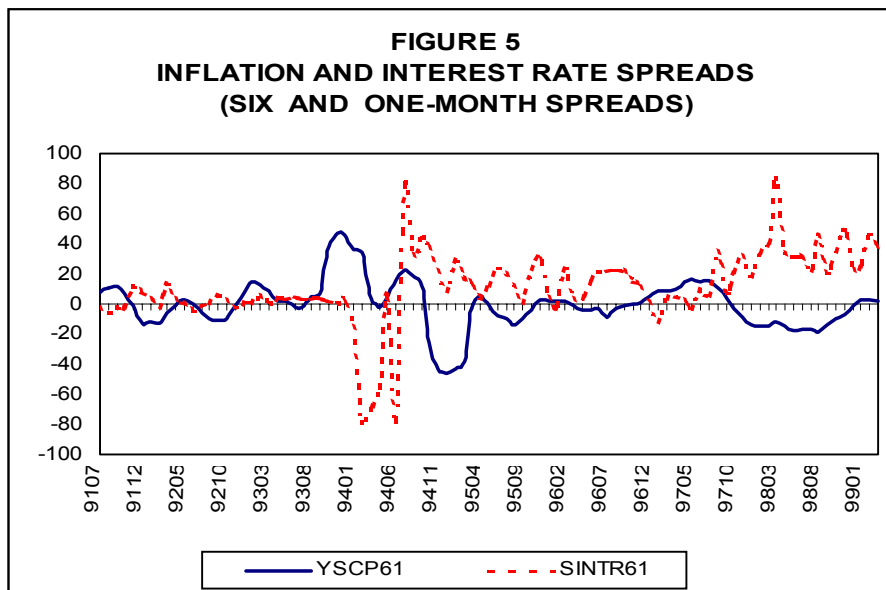
(*) Covers July-December period.

(**) Covers January-March period.

Higher long-term interest rates resulting in positive interest rate spreads with steeper slopes may imply a relatively loose monetary



policy stance and possible inflationary pressures for the future. However, this is not verified for the Turkish data. The movements of interest rate spread and inflation differentials do not exhibit parallel patterns. In other words, as interest rate spread increases the inflation rate spread does not increase, in fact, it decreases in some periods contrary to the expectations. The correlation coefficient between interest rate spread and the inflation differential is negative. The same result is confirmed by estimation results in the following section (Figure 5).



IV. THE METHODOLOGY: MODEL, DATA AND EMPIRICAL RESULTS

IV.A. The Model

Following Mishkin (1991), this paper focuses on estimates of a forecasting equation which tells us whether the term structure of interest rates helps to predict future path of inflation. As formulated in

the reference study, the equation can be stated as a regression of the change in the future m -period inflation rate from the n -period inflation rate $(\pi_t^m - \pi_t^n)$ on the slope of the term structure $(i_t^m - i_t^n)$,

The estimated equation is:

$$(\pi_t^m - \pi_t^n) = \alpha_{m,n} + \beta_{m,n} (i_t^m - i_t^n) + \eta_{m,n} \quad (1)$$

In the reference of Fisher (1930) that equals the expected inflation over m periods to the m -period nominal interest rate minus the m -period real interest rate, Mishkin (1991) formulates the link between nominal interest rates, real interest rates and expected inflation as follows:

$$E_t \pi_t^m = i_t^m - rr_t^m, \quad (2)$$

where $E_t \pi_t^m$ expectations at time t for the inflation rate from time t to $t+m$, i_t^m is m -period nominal interest rate at time t and rr_t^m is m -period (*ex-ante*) real interest rate at time t - i.e., the *ex ante* real return on an m -period bond from t to $t+m$.

The realised inflation rate over the next m periods can be written as the expected inflation rate plus the forecast error of inflation:

$$\pi_t^m = E_t \pi_t^m + e_t^m, \quad (3)$$

where e_t^m is the forecast error of inflation. By substituting in for $E_t \pi_t^m$ from equation 2,

$$\pi_t^m = i_t^m - rr_t^m + e_t^m. \quad (4)$$

Future changes in inflation rate can be modelled as follows:

$$\pi_t^m - \pi_t^n = i_t^m - i_t^n - rr_t^m + rr_t^n + \varepsilon_t^m - \varepsilon_t^n. \quad (5)$$

This equation can be written as an inflation-change forecasting equation as in (1):

$$(\pi_t^m - \pi_t^n) = \alpha_{m,n} + \beta_{m,n} (i_t^m - i_t^n) + \eta_t^{m,n},$$

where

$$\alpha_{m,n} = r^n - r^m,$$

$$\eta_t^{m,n} = \varepsilon_t^m - \varepsilon_t^n - (u_t^m - u_t^n),$$

$$u_t^m = rr_t^m - r^m$$

$$u_t^n = rr_t^n - r^n$$

If expectations are rational and the slope of the real term structure, $rr_t^m - rr_t^n$, remains constant over time, then OLS estimates of $\beta_{m,n}$ will be consistent. In other words, under rational expectations hypothesis $E_t \varepsilon_t^m = E_t \varepsilon_t^n = 0$, and constancy of the slope of the real interest rates implies a consistent estimate of $\beta_{m,n}$ that is unity. If the slope of the real term structure is not constant and the slope of nominal term structure is correlated with slope of the real term structure, then the error term in equation (1) will be correlated with the slope of the nominal term structure and the OLS estimates of the mean slope of the real term structure, $r^n - r^m$ will not be a consistent estimator. However, when the slope of real term structure is not constant, statistical significance of the coefficient of the nominal term structure implies the presence of information about future inflation.

Tests of the statistical significance of the $\beta_{m,n}$ coefficient and whether it differs from unity reveals how much information there is in the slope of the term structure about future path of inflation. A statistical rejection of $\beta_{m,n} = 0$ provides evidence that (1) the term structure contains significant information about the future path of inflation, and (2) assuming rational expectations, the slopes of the

term structures of real and nominal interest rates do not move one-for-one with each other. On the other hand, a statistical rejection of $\beta_{m,n} = 1$ provides evidence that (1) the slope of the real term structure is not constant over time, and (2) the term structure of nominal interest rates provides information about the term structure of real interest rates³.

IV.B. The Data

The empirical analysis makes use of daily data in the secondary Bonds and Bills market. In calculating average interest rates of bonds and bills for different maturities, daily data is weighted by transaction volumes. One, three, six, nine and twelve-month maturities are considered as major time intervals where annual compound interest rates are derived as weighted average of interest rates of securities which have maturities in the range of 20-40, 80-100, 160-200, 250-290 and 340-380 days, respectively. The inflation rates are measured by using both wholesale and consumer price indices which are published by State Institute of Statistics and on monthly basis. The econometric estimations are carried out for the period of July 1991-March 1999.

IV.C. The Empirical Results

The estimation results of inflation change forecasting equations which regress the change in the future m -period inflation rate from n -period inflation rate ($\pi_t^m - \pi_t^n$) on the slope of the term structure ($i_t^m - i_t^n$) are summarised in Table 2 and Table 3. Table 2 contains the results of full sample period, July 1991 to March 1999, while Table 3 contains the results of a subperiod, January 1995 to March 1999. The sample has been split into two according to the change in the market

³ Mishkin (1990b).

structure after the crisis in 1994. As mentioned above, the pattern in the interest rate spreads has changed to a large extent as the fluctuations has become more frequent with widening ranges.

Contrary to the theoretical point of view and previous studies for financially developed markets, the estimation results with Turkish data suggest that the term structure of nominal interest rates have a significant but negative impact on the future path of inflation as reported in Table 2. The estimation results for the whole sample period suggest that $\beta_{m,n}$ coefficient is statistically significant only at 10 percent significance level for three-month maturities while for longer maturities, the coefficient of the term structure is more significant. For time horizons of six months and more $\beta_{m,n}$ coefficient is statistically significant with two exceptions of $\beta_{12,1}$ and $\beta_{9,3}$. As mentioned above, the average maturities in the bonds and bills markets are around 5 months. Maturities longer than six months are considered as long term for the Turkish case and there is a substantial missing data problem for longer maturities, namely 9 and 12-month. Statistically insignificant coefficients of $\beta_{12,1}$ and $\beta_{9,3}$ can be attributed to the missing data problem at those maturities.

TABLE 2
ESTIMATES OF INFLATION CHANGE EQUATIONS⁴
(SAMPLE 1: JULY 1991-MARCH 1999)

$$\pi_t^m - \pi_t^n = \alpha_{m,n} + \beta_{m,n} (i_t^m - i_t^n) + \eta_{m,n}$$

m,n (months)	$\beta_{m,n}$	SE	<i>t</i> -test of $\beta_{m,n} = 0$	<i>t</i> -test of $\beta_{m,n} = 1$	Adjusted R^2
3,1	-0.16	0.09	-1.88**	13.48*	0.09
6,1	-0.22	0.07	-3.15*	17.54*	0.10
9,1	-0.13	0.06	-2.42*	20.51*	0.04
12,1	0.04	0.10	0.34	9.35*	-0.01
6,3	-0.20	0.07	-2.86*	17.31*	0.02
9,3	0.05	0.11	0.48	8.43*	-0.01
12,3	-0.20	0.07	-2.86*	17.31*	0.13
12,6	0.31	0.10	3.04*	6.47*	0.16

* Significant at 5 percent significance level.

** Significant at 10 percent significance level.

The *t*-tests of $1 - \beta_{m,n} = 0$ in Table 2 indicate that the term structure of nominal interest rates contains information about the term structure of real interest rates. For all combinations of m and n , this finding is strongly confirmed. The $1 - \beta_{m,n}$ terms are positive and highly significant suggesting that most fluctuations in the slope of the term structure reflect changes in the term structure of real interest rates on a one-for-one basis and the slope of the term structure of real interest rates is not constant over time.

⁴ Due to the serial correlation problem induced by the use of overlapping data, regressions are based on White heteroscedasticity consistent estimation procedure as outlined by White (1980).

The subsample estimation results indicate that the coefficients of the term structure of interest rates is relatively more significant implying a stronger negative impact on future inflation after the financial crisis in 1994. The $\beta_{m,n}$ coefficients are statistically significant and have higher t-statistics than the whole period estimations. There are three exceptions, $\beta_{3,1}$, $\beta_{9,3}$ and $\beta_{12,6}$. The t-tests of $1-\beta_{m,n} = 0$ in Table 3 also indicate that the term structure of nominal interest rates contains information about the term structure of real interest rates for all combinations of m and n .

TABLE 3
ESTIMATES OF INFLATION CHANGE EQUATIONS⁵
(SAMPLE 2: JANUARY 1995-MARCH 1999)

$$\pi_t^m - \pi_t^n = \alpha_{m,n} + \beta_{m,n} (i_t^m - i_t^n) + \eta_{m,n}$$

m,n (months)	$\beta_{m,n}$	SE	t-test of $\beta_{m,n} = 0$	t-test of $\beta_{m,n} = 1$	Adjusted R^2
3,1	-0.05	0.09	-0.60	11.68*	-0.01
6,1	-0.31	0.09	-3.48*	14.80*	0.17
9,1	-0.48	0.15	-3.31*	10.20*	0.26
12,1	-0.76	0.16	-4.68*	10.83*	0.50
6,3	-0.14	0.06	-2.39*	19.01*	0.03
9,3	0.05	0.13	0.42	7.42*	-0.02
12,3	-0.91	0.37	-2.45*	5.15*	0.14
12,6	-0.68	0.47	-1.45**	3.59*	0.04

* Significant at 5 percent significance level.

** Significant at 10 percent significance level.

The negative and significant coefficient of the term structure of nominal interest rates for Turkish data that is strongly confirmed by the estimation results of this study is not consistent with the findings of other studies carried out for OECD countries.

The high volatility of the real interest rates relative to expected inflation, as well as the negative correlation between these two variables produce significant and negative $\beta_{m,n}$ coefficients as mentioned in Mishkin (1990a) and Mishkin (1991). Specifically, these studies derive the relative variabilities of the expected inflation change and the slope of the real term structure as well as the correlation between expected inflation change and the real term structure slope⁶. Differences in the correlation and relative variation of expected inflation and the real term structure slope produce different $\beta_{m,n}$ and hence different conclusions about the information in the term structure about the future path of inflation. In this context, the evidence suggested by this study is in fact consistent with high volatile structure of the financial market in Turkey. In other words, persistent high inflation and short maturity structure of public sector borrowing which is heavily financed through domestic sources with limited capacity has created an uncertainty and a pressure on

⁵ Due to the serial correlation problem induced by the use of overlapping data, regressions are based on White heteroscedasticity consistent estimation procedure as outlined by White (1980).

⁶ Under the assumption of rational expectations, $\beta_{m,n}$ can be derived to be:

$$\beta_{m,n} = (\tilde{\sigma}^2 + \rho\tilde{\sigma}) / (1 + \tilde{\sigma}^2 + 2\rho\tilde{\sigma}),$$

where $\tilde{\sigma} = [E_t(\pi_t^m - \pi_t^n)] / \sigma[rr_t^m - rr_t^n]$, the ratio of the standard deviation of the expected inflation change to the standard deviation of the slope of the real term structure; and ρ is the correlation between the expected inflation change, $[E_t(\pi_t^m - \pi_t^n)]$, and the slope of the real term structure, $[rr_t^m - rr_t^n]$. This expression is derived by the standard formula for the projection equation coefficient

financial market. This led to a high risk premium and more volatile pattern in real interest rates. Therefore, a negative correlation between the expected inflation and real term structure of interest rates can be attributed to relatively unstable financial market in Turkey.

This result can also be explained in the following framework: A rise in expected inflation associated higher nominal interest rates increases the opportunity cost of holding money. Hence, the demand for government securities rises, but eventually the expected real return of the securities declines (Abken, 1993).

The Turkish economy has experienced widespread financial liberalization over the past ten years. Financial markets relatively deepened while the government securities market expanded considerably. New financial instruments such as government securities, equities appeared as alternatives to bank deposits. The menu of financial assets available to economic agents in constructing their portfolios while hedging against high inflation and other uncertainties has expanded. These developments have taken place while the Central Bank shifted to an environment with indirect monetary policy instruments whereby market rather than direct controls have come to be emphasised in the conduct of monetary policy. It is our view that demand for monetary aggregates must have been affected significantly and the fluctuations of the financial variables increased as a result of these developments. As a conclusion, the findings of this study deviate from the theoretical expectations.

$\beta_{m,n}$, and recognizing that the covariance of the inflation forecast error with $[rr_t^m - rr_t^n]$ equals zero given rational expectations.

V. CONCLUSION

The instability of money demand in mid-1980s reduced the reliability of money-based intermediate target rules in most countries. In addition to the information in the monetary aggregates, the information endorsed in the financial markets has become important in understanding of monetary transmission mechanism that is also becoming a more complicated process. One of the financial indicators that can be used as a guide for monetary policy is the term structure of interest rates in bonds and bills market. This indicator that can be used by the policy makers as a complement to the information in monetary aggregates may be useful for the conduct of monetary policy especially in developed financial markets. In other words, the term structure of interest rates is advised to be a comprehensive information for the monetary policy stance rather than an instrument for the monetary policy.

In this context, many studies carried out for the US and European countries show that the term structure of interest rates can be used for predicting inflation rate. In other words, the interest rate spread or the slope of term structure affects future inflation spread positively. As the maturity of government securities increases the predictive power of term structure to explain future inflation rises. Contrary to the theoretical point of view and previous studies for financially developed markets, the estimation results with Turkish data suggest that the term structure of nominal interest rates have a significant but negative impact on the future path of inflation. The evidence suggested by this study is in fact consistent with high volatile structure of the financial market in Turkey. Imbalances in macroeconomic variables, persistent high inflation and short maturity structure of public sector borrowing which is heavily financed through

domestic sources with limited capacity has created an uncertainty and a pressure on financial markets. Therefore, a negative correlation between the expected inflation and real term structure of interest rates can be attributed to relatively unstable financial market in Turkey. This result indicates that the financial markets in Turkey are not deep and broad enough to extract appropriate information. Therefore, one should evaluate this information with caution.

Similarly, Mylonas and Schich (1999) concludes that the deepening of government securities markets and the development of derivative markets have improved the availability of forward-looking data on financial market expectations and risk dispersions, most importantly for movement in interest rate and exchange rates. However, the information containing in the financial indicators is subject to distortions resulting from various time-varying risk premium. In other words, unlike goods markets, financial markets over-react to the shocks and are susceptible to herding and speculative phenomenon. Thus, this fact limits usefulness of the information in the financial indicators and leaves a large judgmental role to the monetary authorities in assessing the information contained in financial prices. To be informative in conducting monetary policy, the central banks of the countries that have relatively developed financial markets like England and Canada rely on a set of models that also uses financial market indicators.

REFERENCES

- Abken, P. A. (1993): "Inflation and the Yield Curve," *Economic Review*, Federal Reserve Bank of Atlanta, 78, p. 13-31.
- Davis, E. P., and G. Fagan (1997): "Are Financial Spreads Useful Indicators of Future Inflation and Output Growth in EU Countries?," *Journal of Applied Econometrics*, 12, p. 701-14.
- Fama, E.F. (1975): "Short Term Interest Rates as Predictors of Inflation," *American Economic Review*, 65, p. 269-82.
- (1984): "The Information in the Term Structure," *Journal of Financial Economics*, 13, p. 509-28.
- (1990): "Term Structure Forecasts of Interest Rates, Inflation and Real Returns," *Journal of Monetary Economics*, 25, p. 59-76.
- Fama, E.F., and R.R. Bliss (1987): "The Information in Long-Maturity Forward Rates," *American Economic Review*, 77, p. 680-92.
- Fama, E.F., and M.R. Gibbons (1982): "Inflation, Real Returns and Capital Investment," *Journal of Monetary Economics*, 9, p. 297-324.
- Fisher, I. (1930): *The Theory of Interest*, Macmillan, New York.
- Frankel, J.A., and C.S. Lown (1994): "An Indicator of Future Inflation Extracted From the Steepness of the Interest Rate Yield Curve Along Its Entire Length," *The Quarterly Journal of Economics*, p. 517-30.
- Gerlach, S. and F. Smets (1997): "The Term Structure of Euro-rates: Some Evidence in Support of the Expectations Hypothesis" *Journal of International Money & Finance*, Vol. 16. No 2, p. 305-321

- Mankiw, N.G., and A.J. Miron (1986): "The Changing Behaviour of the Term Structure of the Interest Rates", Quarterly Journal of Economics, 101, p. 211-28.
- Mishkin, F. (1981): "The Real Rate of Interest: An Empirical Investigation," Carnegie-Rochester Conference Series on Public Policy, 15, p. 151-200.
- (1988): "The Information in the Term Structure: Some Further Results," Journal of Applied Econometrics, p. 307-14.
- (1990a): "What Does the Term Structure Tell Us About Future Inflation?," Journal of Monetary Economics, p. 77-95.
- (1990b): "The Information in the Longer Maturity Term Structure About Future Inflation," Quarterly Journal of Economics, p. 815-28.
- (1991): "A Multi-Country Study of the Information in the Term Structure about Future Inflation," Journal of International Money and Finance, p. 2-22.
- Mylonas, P. and S. Schich (1999): "The Use of Financial Market Indicators by Monetary Authorities," OECD Economics Department Working Papers, 223.
- Nelson, C.R. and G. W. Schwert (1977): "Short-term Interest Rates As Predictors of Inflation: On Testing the Hypothesis that the Real Rate of Interest is Constant," American Economic Review, 67, p. 478-86.
- Sargent, T.J. (1973): "Interest Rates and Prices in the Long Run" Journal of Money, Credit and Banking 5, p. 385-449.

White, H. (1980): "A Heteroscedasticity-consistent Covariance Matrix Estimator and Direct Tests for Heteroscedasticity," *Econometrica*, 48, p. 817-38.